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Abstract

In the current post-industrial society, knowledge is recognised as a primary source of a company's wealth. However knowledge assets are much more difficult to identify and measure than are the physical assets with which we are much more familiar. (Boisot 1998) As a company's innovative capacity may be dependent upon its ability to take advantage of its knowledge assets, it is important to be able to identify and measure those assets. While large companies can afford extensive knowledge management projects, there is a acute need for a method by which managers in smaller organisations can easily and reliably locate and quantify the components of their knowledge assets in order to maximise their potential for innovation. This paper will begin by definiIlg the concept _of knowled~elements.. within the three functions of the knowledge lite cycle. This cycle will then be in~ated into the well-known four modes of knowledge conversion between tacit and explicit knowledge as proposed by Nonaka (1995). The paper will then describe the identification, from the literature, of measurable, knowledge elements that will give a balance view of knowledge assets across the integrated model. It will then dislillSs way by which managers can determine the value of these elements in their companies and compare them with other indicators of innovation.

Keywords

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EVALUATING THE KNOWLEDGE ASSETS OF INNOVATIVE COMPANIES

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ABSTRACT

In the current post-industrial society, knowledge is recognised as a primary source of a company's wealth. However knowledge assets are much more difficult to identify and measure than are the physical assets with which we are much more familiar. (Boisot 1998) As a company's innovative capacity may be dependent upon its ability to take advantage of its knowledge assets, it is important to be able to identify and measure those assets. While large companies can afford extensive knowledge management projects, there is a acute need for a method by which managers in smaller organisations can easily and reliably locate and quantify the components of their knowledge assets in order to maximise their potential for innovation.

This paper will begin by defining the concept of knowledge elements within the three functions of the knowledge life cycle. This cycle will then be integrated into the well-known four modes of knowledge conversion between tacit and explicit knowledge as proposed by Nonaka (1995).

The paper will then describe the identification, from the literature, of measurable, knowledge elements that will give a balance view of knowledge assets across the integrated model. It will then discuss way by which managers can determine the value of these elements in their companies and compare them with other indicators of innovation.

INTRODUCTION

Knowledge has long been recognised as a valuable resource for organisational growth and sustained competitive advantage, especially for organisations competing in an uncertain environment (Miller & Shamsie 1987). In the current post-industrial society, knowledge is recognised as a primary source of a company's wealth. However knowledge assets are much more difficult to identify and measure than are the physical assets with which we are much more familiar. (Boisot 1998) As a company's innovative capacity may be dependent upon its ability to take advantage of its knowledge assets, it is important to be able to identify and measure those assets. While large companies can afford extensive knowledge management projects, there is a acute need for a method by which managers in smaller organisations can easily and reliably locate, quantify and compare their knowledge assets in order to maximise their potential for innovation.

The paper will begin with an overview of current thinking on the topic of Knowledge Management (KM). It will then introduce the three *functions* of the knowledge life cycle (Bhatt 2000, Tan 2000), the four *modes* of conversion between tacit and explicit knowledge

(Nonaka 1995) and the five knowledge enabling (Von Krogh 2000). The research, reported here, aims to identify, from the literature, a set of knowledge elements that will give a balanced view of knowledge assets across the four *modes* and five *enablers*. An integrated model, which is the result of research to date by the authors, will then be defined. This model combines the functions of the knowledge life cycle and Nonaka's knowledge creation spiral with the notion of I-Space, which has been used to classify information across three dimensions, to form a new model of K-Space, which can be used to classify the knowledge elements. The paper will present this model and discuss the appropriateness of a set of knowledge elements, as a means of measuring the knowledge asset of an organisation. It is suggested that the measure be verified by test the outcomes against established indicators of innovation. The purpose of this research is to determine a practical way by which managers can determine the value of their knowledge assets and track the growth or decline of knowledge in their companies.

KNOWLEDGE MANAGEMENT, TECHNOLOGY AND INNOVATION

Knowledge management is a topic that is being addressed by many academic fields including psychology, business, information technology, economics and many more. KM is clearly an interdisciplinary research area and cross-functional in practice where there is disagreement as to whether KM should be considered a technical issue, a human resources issue, a procedural issue or a part of strategic management (Bollinger & Smith 2001). It is undeniable that advances in information and communication technologies have heightened the interest in knowledge as a strategic resource (McLure, Wasko & Faraj 2000) and knowledge management could be viewed as the latest in a long line of applications of technology for the provision of business solutions in organisations (Bollinger & Smith 2001). However, as Choo (1998) observes, the question of how organisations can use information and communication technologies for KM is much harder to answer than it sounds.

In this paper knowledge management is defined as a set of organisational activities that positively influence knowledge creation, assisting relationships and communication between people, as well as the diffusion of local knowledge through the organisation and across the organisational boundary (Von et al 2000). Information and communication technologies can be considered as drivers or enablers of KM. The authors come from the field of information systems and will therefore emphasise the role of information and communication technologies in these activities while recognising that there are other, non-technical perspectives on KM as defined.

As with researchers in most fields the authors assume the existence of some relationship between innovation and knowledge management. It is the newest information technologies that hold the most potential for innovation in an era characterised by knowledge as the critical resource for business activity (Malhotra 2001). Globalisation, created by new IT, has placed businesses everywhere in a new and different competitive situation where knowledgeable, effective behaviour can provide a competitive edge. In this climate enterprises have turned to explicit and systematic knowledge management (KM) to develop the intellectual capital needed to succeed (Wiig 1999). The so-called "productivity paradox" was based on research into the older IT and showed no relationship whatever between computer expenders and company performance (Ives 1994). The disconnect between IT expenditures and the firms organizational performance may change with an economic transition from an era of competitive advantage based on information to one based on knowledge creation (Malhotra 2000).

Much research in KM grapples with the perceived need to pin down the "soft" concept of knowledge just as has been down with the firmer concepts of "data" and "information". A way forward has been to classify organisational knowledge into two forms "tacit" and "explicit" (Nonaka 1995, Von et al 2000; Kakabads & Kouzmin 2001; Earl 2001). Identifying activities and technology that convert knowledge from one form to another, i.e. tacit to tacit, tacit to explicit, explicit to explicit or explicit to tacit, is significant for two reasons:

1. the activities and technologies, that create and transfer knowledge, are relatively easy to find and hence measure,
2. when seeking to retrieve lost knowledge, eg when employees leave the organisation, activities and technologies can be identifies to capture and manage their knowledge by making it explicit.

Small and medium-sized enterprises (SME) are often a fertile environment for knowledge creation and transfer and hence innovation. Companies who have effective ways to manage their knowledge are much better prepared to face any changes in new economy, and thereby be innovative (Harari, 1994; Nonaka, 1994; West, 1992) and better decide how to invest and to compete (Carneir 2000). SMEs are then suitable sites for the study, and adoption, of KM.

RESEARCH DESIGN AND METHOD

This research is being conducted in two phases. The first phase consists of a literature review and development of a suitable model. The model will be developed and justified in this paper, together with a body of literature used to classify knowledge-converting activities and identify practical knowledge elements to be inserted into the model.

The second phase of the research, which will involve an extensive empirical study, aims to develop a practical indicator of knowledge growth in organisations. This study will use the relationship between knowledge management and innovation to test if there is merit in pursuing a balance in the set of activities converting knowledge between the tacit and explicit forms as has been shown in Japanese companies (Von et al 2000). The paper will discuss preliminary progress on this phase with the development of a suitable set of measurable knowledge elements.

BACKGROUND CONCEPTS

The aim of this first phase of the research is to identify aspects of sound knowledge management theory that could be used to provide an integrated framework for identifying different forms of knowledge and measuring the growth of knowledge in an organisation. The K-Space (knowledge space) model is the result of that research. The contributing theories, and the justification for their integration into the K-Space model, are now presented.

The Life-cycle of Knowledge

Knowledge can be considered to pass through a number of function or phases in a cyclic fashion. The most commonly accepted are the creation, transferring and management as shown in Figure 1 (Bhatt 2000). The core function for organisations in this cycle is management, as it could be said that without management the creation and transfer of knowledge has no direction. Management may be defined in different ways, but common to most definitions used in KM is that knowledge management implies directing, supporting and enabling processes that may be inherently uncontrollable or stifled by heavy-handed direction.(Von Krogh et al 2000).

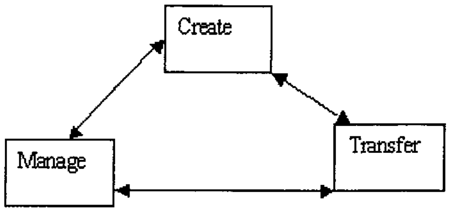

Figure 1 The Knowledge Life Cycle.

In the life cycle of knowledge, "knowledge management" is seen as a set of organisational activities that positively influence knowledge creation and assist relationships and conversations between people as well as the diffusion of knowledge inside or outside organization. In the context of knowledge, management is, in part, an enabling process so that "knowledge enablers" have been defined as follows:

Knowledge enablers

According to Von Krogh et al (2000 p8) there are five knowledge enablers:

1. Instil knowledge vision cycle (IKVC)
2. Manage conversation cycle (MCC)
3. Mobilize knowledge activist cycle (MKAC)
4. Create the right context cycle (CRCC)
5. Globalise local knowledge cycle (GLKC)

Knowledge enablers work in cycles to create and transfer knowledge because knowledge enabling should be thought of in an evolutionary manner, always aimed at continuously improving knowledge, creating and realising the potential of the company. This list is a practical set of processes that can be used in our research and emphasises the importance of the cyclic nature of knowledge processes.

The four modes of knowledge conversion

Nonaka's two-dimensional model for the creation of knowledge, shown in Figure 2, is based on the idea that the constant interaction between tacit and explicit knowledge produces or creates new knowledge. Tacit knowledge is highly personal and hard to formalise, making it difficult to communicate or to share with others (Nonaka 1995 p8). Explicit knowledge is knowledge can be easily processed by a computer, transmitted electronically or stored in database (Nonaka 1995 p9). Explicit knowledge is knowledge that has been externalised and exists in knowledge artefacts. Tacit knowledge, on the other hand, is knowledge embodied within the minds of individual organisational members. Nonaka named the four modes by which these two forms of knowledge interact as shown in Figure 2. Socialization is the process of converting tacit to tacit knowledge. Externalisation is the process of converting tacit to explicit knowledge. Combination is the process of converting explicit to explicit and Internalisation is the process of converting explicit to tacit.

This has led to the knowledge creation spiral of Nonaka and Takeuchi (1995) which views organisational knowledge creation as a process involving a continual interplay between the explicit and tacit dimensions of knowledge, cycling through the modes. In addition four levels of carriers of knowledge in organizations area are assumed, namely individual, group, organisational and interorganisational. The spiral moves and expands as it moves between these levels.

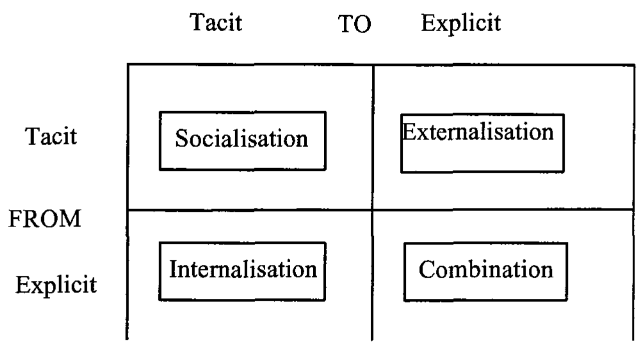

Figure 2 Four modes of knowledge conversion

Knowledge elements

For the purpose of this research, knowledge elements are defined as activities that managers use to manage knowledge in their organisation. These knowledge elements can be classified into four main categories by their support for the modes of conversion between tacit and explicit knowledge. Knowledge elements thus are a set of activities, which can be classified as

- Socialisation elements
- Externalisation elements
- Combination elements
- Internalisation elements

Furthermore, each element can act as a force to move knowledge between the two different forms, tacit and explicit, and the five different knowledge enabler cycles described above. The four modes and five enabling cycles give 20 different categories and it is our assertion that a balanced assessment of these, offer a pragmatic basis for measuring the knowledge creation value of an organisation. One objective of this research is to test the theory that innovation is best enabled by using all four different knowledge creation modes as equally possible (Nonaka 1995). To reach this objective requires a means of identifying and determining the value of knowledge elements.

It is planned to conducted empirical research to create and evaluate a survey instrument that could be used in organisations to determine the cumulative value of its knowledge elements and track these over time. Standard Deviation will be used a measure of how widely values are dispersed from the average value (the mean). The resulting measure of knowledge assets will be validated against established indicators of innovation such as that provided by the Ander Drejer model shown in Figure 3, especially this model is defined innovation management in disruptive technology change situation. The expectation, based on the definition of innovation of Nonaka discussed above is that company Y will be more innovation than company X if it has a lower standard deviation of the value of knowledge elements average across the different modes.

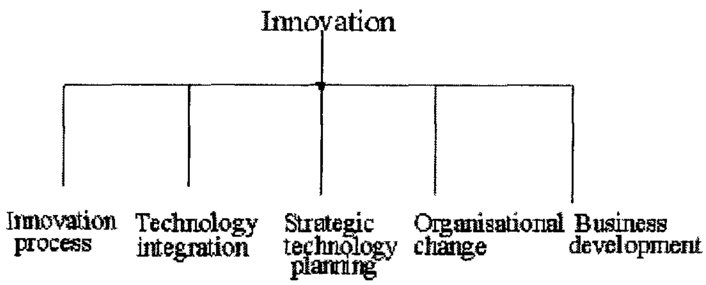

Figure 3 Innovation measures (Ander Drejer model)

An attempt has already been made by the authors to create a balanced list of knowledge elements but it was found that a more formal model was required if the survey instrument used to collect data on these elements was to yield a meaningful outcome. A solution was found in a spatial representation of knowledge elements as follows.

DEVELOPING THE K-SPACE MODEL

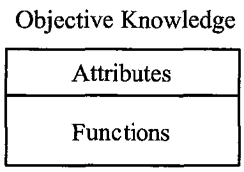

Figure 4: Knowledge as an object

Knowledge as an Object in 3D.

In order to formalise this work is has been found helpful to consider knowledge as an object which can move in space. In the information systems paradigm an object has attributes and functions as shown in Figure 4. The functions, which affect knowledge, are the knowledge elements, as defined above, and the attributes are the properties along the tacit to explicit dimension.

The object moves through space driven by the effect of force. Mathematically space is a cube with three-dimensions. Any object in space can be identified by its position; hence the properties of knowledge are the values on the dimensions of that space. Each of the four modes of knowledge creation (Figure 2) has been represented as a two-dimension rectangle and can be considered as a plane in space as show in Figure 5.

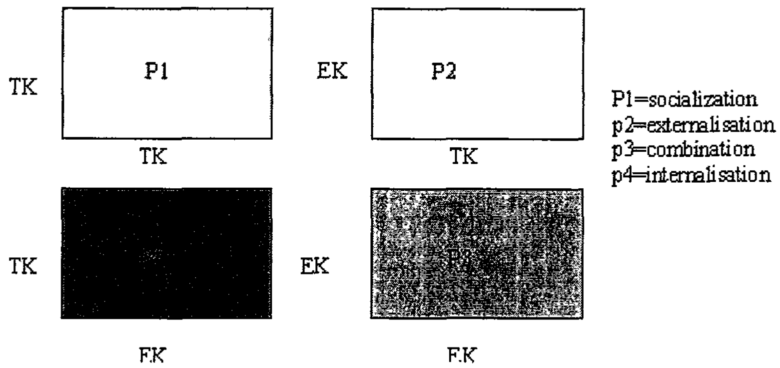

Figure 5 Nonaka's four modes as planes

It has been found to be relatively easy to classify knowledge elements into one of these four planes. The next step is to incorporate the dynamics of the five knowledge enablers. An information system perspective raises three issues: the challenge to codify and formalise, the need to communicate, share and transmit and the importance of retaining context when doing these. These provide three dimensions for a spatial representation of the knowledge enablers.

The Information space

Support for the view of knowledge as an object in space comes from the analogous concept of I-Space, which was developed by Boisot (95; 98) for information. I-Space is a cube, shown in Figure 6) that brings together the three essential dimensions of information; codification, diffusion and abstraction, with an associated scale that ranges from codified to uncodified, from diffused to undiffused and from abstract to concrete (Shariq 1998).

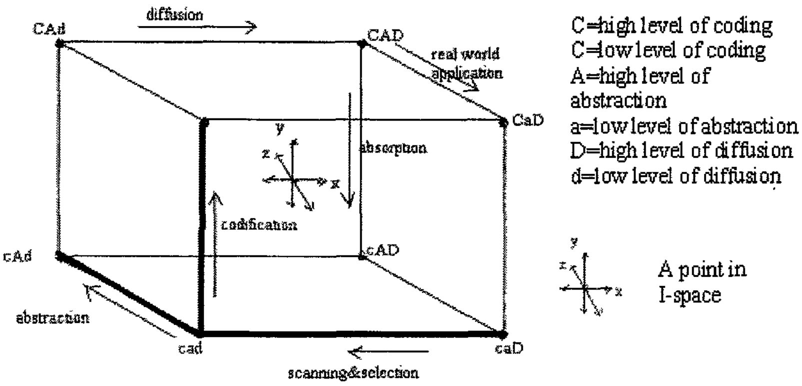

Figure 6: The dimensions of I-Space (Ashford 1997)

From I-Space to K-Space: Knowledge and information

The concept of knowledge elements, as defined above, is now imposed onto the I-Space model to create a corresponding model for knowledge objects, the K-Space. This involves a mapping of the dimensions of tacit and explicit knowledge elements onto the dimensions of information in the I-space, ie: codification, diffusion and abstraction. There are many similarities in the processes associated with knowledge and information. Both can be shared (Eschenfelder et al 1998, Cook 1999, Byrne 2000) ,codified (Haldin-Herrgard 2000)) and encapsulated (Hildreth, et al 2000), Ohr 2000, Baster et al 2001).

In information systems terms, knowledge results from the processing of information just as information is a processing of data (Hasan 2001). However knowledge could result form the processing of data where the result is new knowledge and there is a constant dynamic of interchange between all three: data, information and knowledge (Callioni 2002). For the purposes of building a model of K-Space we content that the processes of sharing, abstracting and codifying information can be transferred to the concept of knowledge with some restrictions on the meaning of information and meaning of knowledge. In particular the importance of context is a feature that distinguishes knowledge from information. (Brakensiek 2002, Leonard & Sensiper 1998). Context is added to information through utility, as knowledge is often defined as information in action (Sveiby 1997).

Utility as the context of knowledge

Utility is defined as the outcome of the management of knowledge. Utility and context distinguish knowledge from information. Knowledge affects the organisation at different levels including operational performance, the way that employees do their jobs and the way that the managers make their decisions. The utility of knowledge transcends organisational boundaries, to the life of employees and into society.

Knowledge increases proficiency in the performance of complex cognitive tasks (Wyman et al 1998). Moreover, sharing knowledge affects team knowledge, as result the team attitude becomes much more focussed on information sharing, transactive memory, group learning and cognitive consensus (Mohammed & Dumville 2001). Costly errors are caused when knowledge is not shared (Hoopes & Postrel 1999). Competitive advantage (Yli-Renko et al 2001), the influence of decisions (Borg 2001) and effective management of the change (Coffman 2000) are the result of knowledge exploitation. The current emphasis on knowledge management is greatly shifting the way which employees do their work and the way which leadership is defined (Tyson 1999). Knowledge helps employees to reduce the cycle time of doing their jobs (Lynn 2000). Indeed the ultimate utility of knowledge management in organisations is innovation.

Mapping the forms of knowledge onto the dimensions of information

As shown in Figure 6, the dimensions of information in I-Space are represented as the level of coding (C=high and c=low), the level of abstraction (A=high and a=low) and the level of diffusion (D=high and d=low). These will now be discussed in terms of knowledge rather than information by adding the concepts of utility and context.

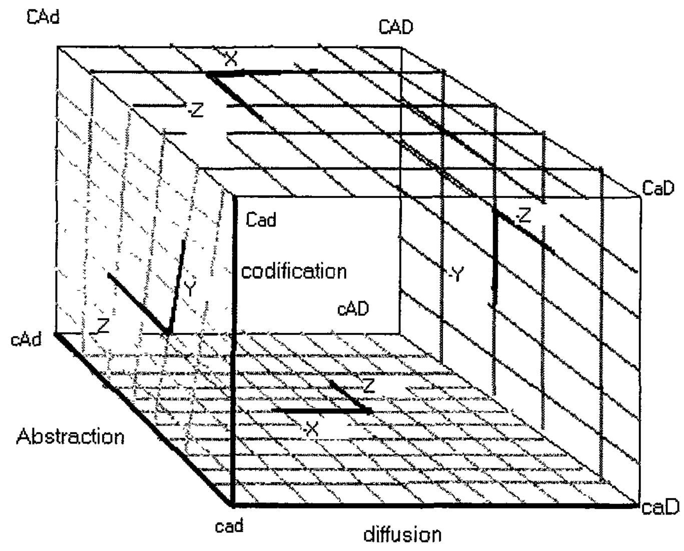

Figure 7: The K-Space with dimensions of Codification, Diffusion and Abstraction

Codification: The height of the cube represents codification, which relates to the level of classification, aggregation and analysis (Ashford 1997). The need for codification is enhanced by information technology and varies with managerial level. There is a positive relation between high technology use and a manager's ability to

- Answer the common questions of "who", "where" and "when" (Choo 2000).
- Change the methods used to manage the organization for innovation (Gray 2001, Abraham & Knight 2001).
- Increase performance (Sircar et al 2000).

Based on this, management theory suggested that managers with the greatest ability to interpret codified knowledge should be at the highest level of the organisation.
Diffusion: can be defined as the availability of information and knowledge for sharing, transmission and interchanging inside and outside organisation.
Abstraction can be defined as tendency of information or data to be free of the context of the community.

THE PLACE OF TACIT AND EXPLICIT KNOWLEDGE IN THE K-SPACE

Nonaka's four modes of knowledge conversion are based on the idea that knowledge is created as a result of interaction between tacit and explicit knowledge. In our model, the categories of tacit and explicit are further divided into two forms, based on the extent of diffusion and shown in Table 1.

	Diffusion	
Knowledge form	D (high)	d (low)
Tacit		
Explicit		
Semi-Tacit		
Semi-Explicit		

Table 1:Forms of knowledge based on diffusion

Nonaka's four tradition modes of knowledge conversion occupy faces on the K-Space cube. The bottom face of the cube embraces the socialization plane (p1), tacit to tacit. The left side of the cube embraces the externalisation plane (p2), tacit to explicit. The top face of the cube embraces the combination plane (p3), explicit to explicit. The right side of the cube embraces the internalisation plane (p4). In all of Nonaka's forms the codification dimension is small even for explicit knowledge. (Walter Swap; Dorothy Leonard; Mimi Shields; Lisa Abrams; 2001).

Tacit knowledge in both forms is represented on the bottom face of cube. The points [cad,cAd,cAD,caD] delineate the tacit plane and the diffusion dimension distinguishes whether a knowledge element is semi or complete tacit. The level of abstraction determines by how much knowledge is proper removed from its context. When knowledge is removed from its context more understanding is needed and knowledge is little more than information. We use "capital A" [cAd,cAD] for knowledge in its proper context. We are currently looking for knowledge enablers that will allow the organization to recreate the right context for codified knowledge.

The prefix "semi" extends the classical definitions of **tacit** and **explicit** from Nonaka's work (1995) where **tacit** knowledge is highly personal and difficult to share but not impossible and **explicit** knowledge is easily processed and transmitted. Tacit knowledge, which is undiffused, is highly **tacit.** In contrast if tacit knowledge is highly diffused it can be thought of as **semi-tacit** as it takes on a more overt form, as it is more widely known. On the other hand, **explicit** knowledge, which is undiffused is only **semi-explicit** or relatively private.

Nonaka (1995) segmented tacit knowledge into two dimensions: the technical dimension and the cognitive dimension where the technical dimension is much easier to diffuse than the cognitive one. Hence technology enables highly diffused tacit knowledge, i.e. "semi-tacit" knowledge that is easier to convert to an explicit form. On the other hand, completely tacit knowledge is less diffused when it is contained in mental models, beliefs and perceptions. This type of knowledge is not easy to diffuse by technology until it is codified.

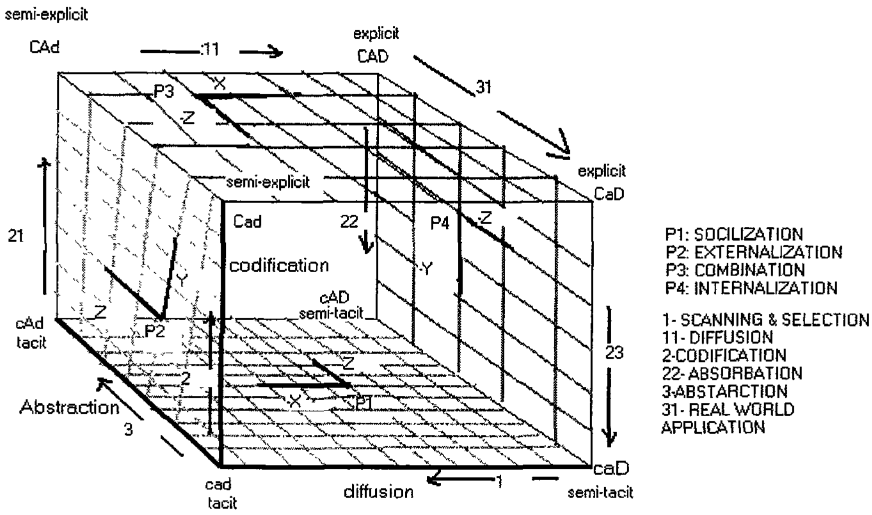

Figure 8: K-Space showing the four planes on cube

Explicit knowledge in both forms are represented in the top of the K-Space (P3) delineated by the points [Cad,CAd,CaD,CAD]. The diffusion dimension determines whether the knowledge element is semi or complete explicit and the abstraction dimension give the degree of context. This is so often the problem with information stored in traditional technical database systems where the context of the data is lost. The codification dimension in all forms on this plane is high, a quality that often distinguishes between tacit and explicit knowledge elements (Marwick 2001).

The right face of the cube (P4) knowledge represents the internalisation process and can often be treated as explicit knowledge or even information (CaD,Cad, cad,caD) that is internalised by people and becomes tacit by their interpretation. Technologies that aid this function are the Internet, knowledge repositories or specialised information systems, which can often add some element of contextual information. Knowledge without context will not added any value to organisations (Merlyn & Välikangas 1998).

KNOWLEDGE CREATION AND THE LOCATION OF KNOWLEDGE ELEMENTS IN K-SPACE

The knowledge creation spiral described by Nonaka cycles around the cube as shown in Figure 9. The cycle may be started at different points and take different paths. These correspond to the five different knowledge enablers described earlier. The "instil knowledge vision cycle" (IKVC), is one of those cycles which could start from (caD) or (cad). The "manage conversation cycle" (MCC) would probably start at the socialisation plane because this cycle is more related to generating knowledge from sharing between people.

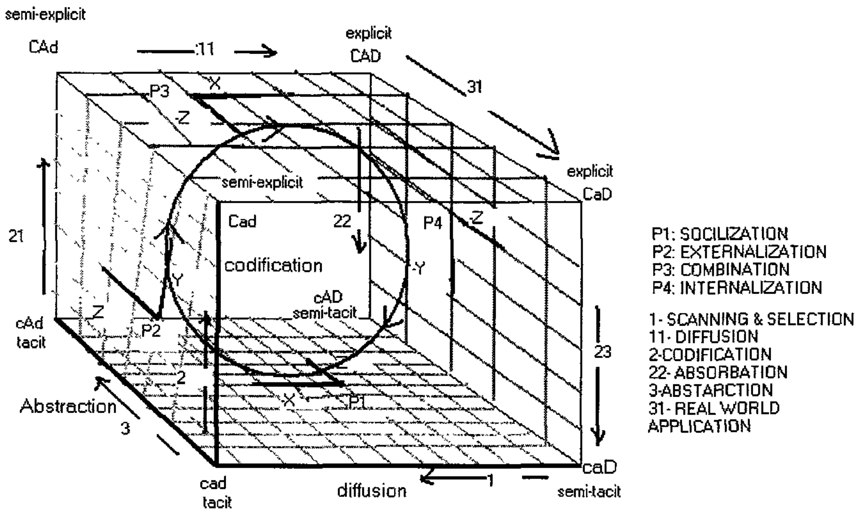

Figure 9 Knowledge enabling cycles in K-Space

The positions of elements on these planes are proving to be very important in determining where the knowledge elements are located. A practical set of knowledge elements is currently being refined. The first step in this process is to choose a balanced set of elements in each of the four planes equivalent to Nonaka's four mode of knowledge creatio n. The next step is to identify these elements within the five knowledge-enabling processes. Some examples will now be given, firstly of elements, and tools to support them, in the four planes and then two examples of knowledge elements within the "instil knowledge vision cycle" (IKVC) knowledge enabler that are positioned on different planes.

Plane 1 in K-Space (**socialisation**) represents the processing of converting knowledge from tacit to tacit forms. Knowledge elements located in this plane would be items that encourage participation in conversions between people. There may be techniques for including people with variety of educational backgrounds, ages, professional skills and functional responsibilities in a conversation or identifying the rituals that encourage entering conversation (Von et al 2000). Knowledge elements in this plane would need systems that assist people in scanning knowledge or provide patterns or schemas to help people make sense of tacit knowledge.

Plane 2 in K-Space (**externalisation**) is the processing of converting tacit to explicit knowledge, with the starting point of tacit knowledge very undiffused. These processes could be strongly affected by two dimensions: abstraction and codification. As the codification dimension increases tacit knowledge is easily converted to explicit without other processing. Thus any function that helps codification, such as sorting, classification and justifying would be located towards the top of this plane. Lower on this plane are functions more akin to prototyping. Here knowledge can be converted from tacit to explicit in a trial and error mode using computer aided design tools, case tools or end-user programming environments which do not necessarily yield a complete application.

Plane 3 in K-Space (**combination**) is the process of systematizing the concepts in a knowledge repository (Nonaka 1995). The coordinates of diffusion and abstraction determine the position of a knowledge element on this plane, as the codification is usually high. Most traditional information systems therefore play a significant role.

Plane 4 in K-Space (**internalisation**) is the processing of knowledge from explicit to tacit. This plane is the antithesis of plane 2, with the diffusion value high as the explicit knowledge is easily transmitted through electronic systems. Knowledge elements found here vary in their degree of codification and abstraction. In the process of becoming tacit the knowledge losses its degree of classification and increases its degree of context. Internets, Intranets and Portals may play roles to support knowledge elements here.

IKVC Example 1. **"Dedication to direction"** is one knowledge element that can contribute to the knowledge enabler: the "instil knowledge vision cycle". In this approach, the vision of company is created from knowledge, which is highly specified and managers carefully and deliberately construct an explicit road map depicting the way to achieve their knowledge vision. When the vision is highly specified, the people in organisation can create and share knowledge in a highly codified form that is easy to convert into the electronic form of a machine as text or data. Therefore **"dedication to direction"** can be classified as a "combination" knowledge element in Plane 3.

IKVC Example 2. **"Commitment to generativity"** in organisations is another knowledge element that can contribute to the knowledge enabler: the "instil knowledge vision cycle". Here the organisational vision is shared among employees who play a major role in helping the organisation to be successful (Hodgkinson 2002.). This approach to determining the knowledge vision results in new thinking, new ideas, phrasing and actions from the people (Von Krogh & Roos, 1997). Consequently, the vision is created from human knowledge, which is difficult to formalise into codes or rules. Generativity in organisation can be accomplished by stimulating the employees to consider how information is conceptualised in the organisational context. A knowledge creation and sharing process among them leads to diffuse knowledge that is the property of humans, and not necessarily authenticated. The conceptualisation of this form of knowledge is a changeable process, depending on source and context. Knowledge created from documents, the Internet or any highly diffused resource is transferred to teams or groups and then it can be converted to individual human knowledge. Therefore, "commitment to generativity in organisation" can be classified as a "socialisation" knowledge element in Plane 1.

These two examples from the same knowledge enabling cycle illustrate the diversity that exists in the range of candidates for the set of knowledge elements. Determining a comprehensive, yet workable, set of knowledge elements is the challenge of this research

CONCLUSION

The K-Space model explains the concepts of Nonaka's (1995) four knowledge creation processes and the five knowledge enablers of Von Krogh et al (2000 p8), which are widely accepted as a valid basis for knowledge management theory. The K-Space model is providing us with a formal framework for locating and giving a utility value to knowledge elements with a dynamic, contextual environment. These knowledge elements or manager activities are supported by human and technology tools that make knowledge management an integral part of the work process.

The next phase of the research will be to survey managers in organisations from different industries to both confirm and refine our set of representation knowledge elements and to place them on the K-Space. The survey instrument is currently being design to cover all areas of the K-Space. A triangulation method will synthesize results from three different questionnaires for business managers, IT managers and employees. This analysis will provide us with a balanced set of knowledge elements in the four by five (20) categories. Furthermore, managers and IT managers will be interviewed to see what are the most common tools they used in their company to manage innovation and knowledge and what they think the processes of innovation and knowledge management mean for them. The count of knowledge elements (KE) will be used as a measure of the knowledge assets of the company. A measure of innovation, as mentioned above, will also be determined and used to calibrate the measure of knowledge assets in each company. We anticipate that these measures will vary with industry.

Once the measure is calibrated it can be used in businesses as a measure of their overall knowledge assets. It will also be used to determine the extent to which these assets are balanced across the four modes and five knowledge enablers and to identify any knowledge gaps. The latter will be measured as (abs(total number of KE in a category – number of KE they already have in that category)).

Organisation can identify what tools can be used to support the identified knowledge elements gaps in the organisation. Some companies have a variety of knowledge management tools in their organisation such as e-mail, the Internet, intranets and libraries but not all adequately support a balanced view of knowledge management process. This can be done in any organisation and would be particularly useful in SMEs where the process of knowledge management is often not well understood.

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